LAY-IN CEILING SPEAKER

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CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. §119(e) to co-pending provisional patent application Serial Number 60/211,574, filed June 15, 2000, the entirety of which is incorporated by reference herein.

FIELD OF THE INVENTION

The present invention relates to speakers for placement in ceilings, walls, and the like. The present invention is specifically directed to a low profile, lightweight, fully assembled lay-in speaker system which replaces a standard ceiling tile.

BACKGROUND OF THE INVENTION

Conventional speakers oftentimes require holes to be cut in a ceiling tile so that the speakers can be placed in the holes. Cutting ceiling tiles is messy, costly, and time-consuming. It also decreases the structural integrity of the ceiling tile. Conventional speakers also require substantial expense of time and labor for the installation, and cost in terms of hardware required for mounting.

Access to conventionally mounted speakers is also problematic. Particularly in large buildings, such as theaters or offices, access to conventionally mounted speakers for cleaning, maintenance, and adjustment is cumbersome and labor intensive. Additionally, individual speaker volume control is not readily accessible for conventionally mounted speakers.

Furthermore, conventional speakers are heavy, thereby requiring additional support, such as wire hangers, to connect the speaker to the ceiling. See, for example, U.S. Pat. No. 4,923,032 to *Nuernberger*.

In addition, conventional speaker do not provide a minimum three-hour burn rating. While building codes require burn-resistant materials to be used in ceiling tiles themselves, building and fire codes do not require burn-resistant materials to be used in speakers, creating a potential fire hazard. Conventional backboxes are made of a metal, such as steel, which do not provide a three-hour burn rating. Thus, a fire hazard exists wherever a conventional speaker is located.

SUMMARY OF THE INVENTION

The present invention, which is defined by the claims set out at the end of this disclosure, is intended to solve at least some of the problems noted above. A speaker enclosure is provided that includes a backbox having a peripheral edge; a grill that is crimped around the peripheral edge of the backbox, and a sound-baffle sheet disposed between the backbox and the grill. An opening is placed in the sound-baffle sheet for placement of a speaker.

Also provided is a speaker system having a speaker, a backbox having a peripheral edge, a grill that is crimped around the peripheral edge of the backbox and to which is affixed a speaker, and a sound-baffle sheet disposed between the backbox and the grill. The crimping of the grill serves several other purposes. It makes a nearly airtight seal with the grill and sound-baffle sheet, which minimizes possible smoke seepage between the room and the ceiling. Further, it prevents sound waves from the front of the speaker from entering the enclosure and canceling at various frequency points. The sound-baffle sheet has an opening in it to accommodate the speaker.

Crimping the grill over the backbox increases the strength of the backbox, thereby providing structural integrity both to the grill and backbox. In addition, the backbox preferably is made of a material that has good high temperature insulation properties to achieve a three-hour burn rating.

The speaker system of the present invention offers a number of other advantages over speakers known to the prior art. Because of its size and dimensions, there is no need to cut ceiling tiles to accommodate the speaker, which eliminates the mess and difficulty normally

present with installing speaker systems in ceilings. The lay-in speaker system also provides easy access for maintenance and repair by providing access through adjacent ceiling tiles. The speaker system also provides an inconspicuous front accessible volume control for the speaker. In addition, the integral backbox meets or exceeds ASTM E84 flame and smoke test with 3 hour burn.

Further advantages, features, and objects of the invention are apparent from the following detailed description of the invention in conjunction with the associated drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a preferred embodiment of a speaker enclosure made in accordance with the invention.

FIG. 2A is a top plan view of a preferred embodiment of a grill made in accordance with the invention.

FIG. 2B is a perspective view of the grill of **FIG. 2A**.

FIG. 2C is a side plan view of the grill of **FIG. 2A**.

FIG. 3A is a top plan view of a preferred embodiment of a sound-baffle sheet without the speaker opening, made in accordance with the invention.

FIG. 3B is a top plan view of the sound-baffle sheet of **FIG. 3A**, which includes a speaker opening.

FIG. 4 is a perspective view illustrating the ventral side of the speaker system, which includes the grill, sound-baffle sheet, and speaker made in accordance with the invention.

FIG. 5 is a cross-sectional view of the speaker system illustrated at lines 5-5 in **FIG. 1**.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings, a first preferred embodiment of the speaker enclosure system in accordance with the present invention is illustrated in **FIG. 1** at the reference numeral **10**. The speaker enclosure system **10** is a ceiling speaker preferably having the same size as a standard ceiling tile. As such, the speaker enclosure system **10** is designed to replace

an entire ceiling tile and to rest on the same tile framework support. Thus, the speaker enclosure system **10** does not require any additional framework or support for placement on ceiling other than the framework already installed for the tile. The speaker enclosure system **10** therefore blends in with the rest of the ceiling tiles and does not obstruct access to, or the view of, the ceiling.

Unlike conventional ceiling speakers, there is no need to cut a ceiling tile. A standard 2 foot by 2 foot size is useful for the speaker enclosure **10**, although the speaker enclosure system **10** can be made of virtually any size to match the size of the existing ceiling tiles.

In a preferred embodiment shown in **FIG. 1**, the speaker enclosure system **10** has a backbox **20,** which encloses the speaker in order to comply with building codes. The backbox **20** includes a peripheral edge **22**, walls **24** and an upper surface **26**. As illustrated, the walls **24** are angled and slightly curved. It is within the scope of the present invention to provide walls of other shapes if desired. The walls **24** meet at edges **28**, which are slightly curved as illustrated. Backboxes having other shapes and sizes are well within the scope of this invention. The upper surface **26** of the backbox **20** includes an electrical connection box **25**, known to the art for supplying electricity to the speaker.

Preferably, the backbox **20** is a concave, molded, one-piece form having the top surface **26**, sides **24** and an edge **22**. More preferred is a concave, molded, one-piece fiberglass, mineral fiber, or other suitable fiber-covered material, form enclosed on one side by a foil or other suitable metallic coating. The fiberglass and foil combination provides a light-weight construction.

The backbox **20** also preferably is made of a material that is flame resistant. More preferably, it has a three-hour burn rating. The fiberglass and foil combination provides such a three-hour burn rating. The material preferably passes an American Society for Testing and Materials (ASTM) E84 flame and smoke test, which is a standard test method for surface burning characteristics of building materials. The method assesses the spread of flame on the surface of a material and is often referred to as the " Tunnel Test." The test involves installing a sample of material 20 inches wide and 25 feet long as the ceiling of a horizontal test chamber. The material is exposed to a gas flame on one end of the tunnel for a period of 10

minutes. The rate of flame front progression on the material is compared to selected standards and calculations made to produce a flame spread rating. The fiberglass and foil combination pass the ASTM E84 test. Also useful is a backbox **20** material that passes a Underwriters Laboratories (UL) 181 erosion and impact test. This test measures the fire resistance and surface burning characteristics of materials and fabrics, as well as ventilation characteristics of products installed in air ducts. The Standard evaluates a risk of fire, electric shock, or injury to persons, using the appropriate additional component and end-product requirements as necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this Standard. The test is designed for any product that contains features, characteristics, components, materials, or systems that are installed in air ducts. Products are classified based on their combustibility.

Illustrated in **FIGS. 2A-C**, the speaker enclosure system **10** also includes a grill **30** that is crimped at edges **34**, as illustrated in **FIG. 1**. The edges 34 are designed to crimp around the peripheral edge **22** of the backbox **20**. The backbox **20** can also be attached to the grill **30** by other means such as adhesive, mechanical fasteners or an overlying piece to press the backbox **20** against the grill **30**.

A preferred grill **30** is illustrated in **FIGS. 2A-C**. The grill **30** preferably is a perforated sheet designed to allow sound from a speaker **50** (illustrated in **FIG. 4**) to pass through it. Preferably, the perforations **31** are large enough to allow a screwdriver or similar device to be inserted through them. This permits adjustment of a volume control (not shown) on the speaker **50**, which is shown later in **FIG. 4**. Conventional grills typically have smaller perforations through which do not accommodate a screwdriver or other similar tuning device. Thus, to adjust the volume on a speaker having a conventional grill, a hole must be drilled to enlarge the perforation or a speaker adjustment knob must be placed on the exterior surface of the grill.

Referring to **FIG. 3A**, a sound-baffle sheet **40**, preferably made of vinyl or thin MYLAR, is disposed between the grill **30** and the backbox **20**. Preferably, the sound-baffle sheet **40** is constructed of two pieces **40a** and **40b** that are placed side-by-side as is shown in **FIG. 4**. However, the sound-baffle sheet **40** can be constructed of a single piece. A series

of openings **42** are cut in the sound-baffle sheet **40b** as is shown in **FIG. 3B**. Typically, the size of the opening **42** approximates the diameter of the speaker **50**. A second opening **43** of appropriate dimension may be added to the sound baffle sheet away from the speaker to introduce tuning of the enclosure to improve the low frequency response of the unit.

The speaker **50** is placed over the opening **42** of the sound-baffle sheet **40b** as is illustrated in **FIG. 4**. The speaker **50** is then attached to the grill **30**. Preferably, the attachment is permanent, such as by rivets, nuts and bolts or other attachment devices **51** attaching the speaker **50** to the grill **30** through the perforations in the grill **30**.

Referring to **FIG. 4**, the sound-baffle sheet **40** forms an effective acoustical baffle. Sound waves emitted from the baffle **54** of the speaker **50** exit through the perforations of grill **30**. Because sound waves can return to the speaker enclosure system **10** through the perforations **31**, which tends to distort or dampen sound and is not desired, the sound-baffle sheet **40** acts to prevent sound waves from reentering the speaker **50**. Thus, the sound moves into a room and is not dampened or canceled. The speaker **50** may be any speaker known to the art.

Illustrated in **FIG. 5**, the grill **30** is secured to the backbox **20** by crimping the edges **34** of the grill **30** around the peripheral edge **22** of the backbox **20**. **FIG. 5** shows the backbox **20** and the grill **30** before the grill edges **34** are bent over the peripheral edge of the backbox **20**. The crimping strengthens the backbox **20** and grill **30** combination, thereby providing additional structural integrity to the combination. The crimping also provides an economical method of speaker construction by eliminating the need for additional hardware to hold the speaker enclosure together. The elimination of additional hardware also reduces the cost of the speaker enclosure as a whole. In addition, crimping provides an easy and reversible means to disengage the backbox **20** from the grill **30** if it is necessary to separate the two.

The speaker enclosure **10** can also be manufactured with a sound masking generator built into the system. The appearance of the grill **30** is appropriate for the sound of the sound masking generator, i.e, it sounds like air coming from a ventilation grill. The unit has an appearance similar to a ventilation grill.

It is understood that the various preferred embodiments are shown and described above to illustrate different possible features of the invention and the varying ways in which these features may be combined. Apart from combining the different features of the above embodiments in varying ways, other modifications are also considered to be within the scope of the invention.

For example, the speaker enclosure **10** can be used in a ceiling or a wall. The speaker enclosure **10** can be placed where two adjacent walls meet, preferably near the ceiling.

The invention is not intended to be limited to the preferred embodiments described above, but rather is intended to be limited only by the claims set out below. Thus, the invention encompasses all alternate embodiments that fall literally or equivalently within the scope of these claims. It is understood that in the claims, means plus function clauses are intended to encompass the structures described above as performing their recited function, and also both structural equivalents and equivalent structures. As an example, though a nail and a screw may not be structural equivalents insofar as a nail employs a cylindrical surface to secure parts together whereas a screw employs a helical surface, in the context of fastening parts, a nail and a screw are equivalent structures.